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An overview of organic aquaculture in Italy

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(Article begins on next page)

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Abstract

The total Italian organic aquaculture production in 2015 was of 2347 t, and it accounted for almost 1.1% of the total Italian aquaculture. This situation is comparable with that of other western countries, where organic production accounts for about 1.5 – 2% of the total aquaculture production. Between 2013 and 2014, the number of organic fish farms in Italy more than doubled, that is, from 17 to 41 farms. Most of these organic fish farms are located along the Adriatic coast and in North East Italy (Veneto region), and the main farmed species in that period was blue mussel, followed by gilthead sea bream and rainbow trout. Organic aquaculture is generally considered a promising and growing sub-sector of aquaculture in Italy and in other European countries, and a number of supporting research initiatives have recently been implemented by the Italian Ministry of Agriculture and Forestry. However, despite these efforts, a clear fact has emerged: only a small percentage of Italian fish farmers demonstrated any interest in producing organically until 2013. The demand for organic aquaculture products in Italy is increasing, particularly among people that are regular organic food consumers. However, there are a number of critical aspects that still need to be addressed: the difficulty of introducing organic aquaculture products into large-scale retail operations, the high prices of the key fish feed ingredients, the difficulties in adapting Directive (EC) 710/2009 to aquaculture and the application of long-term marketing strategies. This paper tries to provide a realistic perspective of organic aquaculture, and thus includes not only the proximate causes (i.e. technical and regulatory aspects) of the current production, but also the remote historical, geographical, political and arithmetical reasons.

Keywords	organic aquaculture; consumer information; Italian aquaculture; aquaculture products; organic fish farm
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Opposed reviewers	Marco Saroglia

Submission Files Included in this PDF

File Name [File Type]

Aquaculture BIO Italia - Answer to reviewers - April 19th 2019.docx [Response to Reviewers]

Sicuro 2019 - Org aquac - Highlights.docx [Highlights]

Sicuro 2019 - Organic aquaculture in Italy - REV April 8th 2019.docx [Manuscript File]

Sicuro 2019 - Organic aquaculture in Italy - Figure 1 - updated.docx [Figure]

Sicuro 2017 - Organic aquaculture in Italy - Figure 2.docx [Figure]

Sicuro 2019 - Org aquac- Fig 3.docx [Figure]

Sicuro 2019 - Org aquac - Tab 1.docx [Table]

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Sicuro 2019 - Org aquac - 3rd letter to editor - April 19th 2019.docx [Author Statement]

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Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:

This manuscript is a review and I did not use any personal research data. I only analyzed aquaculture production data from different countries

Comments from the editors and reviewers:

-Reviewer 1

-

-Reviewer 2

- The key information on Italy is some four years out of date - surely, much has changed since then.

I question some of the assertions in the paper, not least that the UK was the first organic fish producer in 2009 (l. 68). Aarset, Tveteras and Norwegian and UK colleagues had been researching and producing papers for a decade on the subject - see Aarset, B. *et al.* (2004). The European consumers' understanding and perceptions of the 'organic' food regime. The case of aquaculture. *British Food Journal*, **106**, 93–105. It is also inconsistent with the statement you make in l. 263, where you state that 'Italian organic aquaculture is more than 20 years old ..'; this surely then predates 2009 by a decade.

Also, I dispute the fact that 100% of Irish farmed salmon and trout is organically produced, despite the BIM report.

English and grammar still require an overhaul e.g.

l. 50. ‘.. it is useful to consider Italy in an ..’.

l. 78. ‘.. in Europe is Ireland, which is ..’.

Dear Reviewer 2,

thank you for your comments (in red) on my manuscript, here my answers to your questions.

The key information on Italy is some four years out of date - surely, much has changed since then.

I already updated references on Italian aquaculture in the last version of the manuscript (Di Marco et al., 2017), however, following your suggestions, in order to give to the reader a most possible updated description of Italian organic aquaculture, I searched new references, reports and articles eventually published in the last months, particularly in Italian. I did not find more recent data on production that are still referred to those of 2015, but I found new data on number of the farms, that confirm previous ones. The number of organic farm is still of 41 (see attached table)

I introduced following sentence in the manuscript:

“Recent data on organic fish farms (SINAB 2014; SINAB 2015) indicated an unexpected increase to 41 farms in 2014 with a successive stationary phase until 2017 (SINAB, 2018), thus showing an increase of more than 140%.”

I integrated these results in the manuscript and I updated Fig.2

The most relevant documents I found are:

-a project on organic aquaculture product consumers BIOBREED (2016)

(<http://www.biobreed.it/BioBreed/HOME.html>) carried out by Italian Council for Agricultural Research and Economics which become to the Italian Ministry of Research and University (MIUR)

- an Italian report of SINAB 2018 (http://www.openfields.it/sito/wp-content/uploads/2018/09/Bio-in-cifre-2018-_-Anticipazioni.pdf) where I found updated information about Italian organic aquaculture farms (see table 9). This document is particularly interesting for organic aquaculture in Italy, in fact I already consulted previous issues of 2015 and 2014 (SINAB (2014). BIO in cifre 2014 1-81 Available at <http://www.sinab.it/sites/default/files/share/OK!!..pdf> (In Italian); SINAB (2015) BIO in cifre 2015 1-94 Available at <http://www.sinab.it/sites/default/files/share/OK!!..pdf> (In Italian)

Sentence introduced in the manuscript:

positive aspect recently resulted by the project BIOBREED (<http://www.biobreed.it/BioBreed/HOME.html>) is the positive consumer's perception of organic aquaculture products as reaction to a general negative sentiment of conventional aquaculture products. Italian consumers believe that pharmaceutical treatments are strongly reduced in organic aquaculture (Pulcini & Capoccioni 2018)..

Updated references

Pulcini D, Capoccioni F (2018). Il consumo di pesce allevato e biologico in Italia (*in Italian*). Edizioni Bet Multimedia pp 66. Available on line at

http://www.biobreed.it/BioBreed/HOME_files/II%20consumo%20di%20pesce%20allevato%20e%20Biologico%20in%20italia.pdf

SINAB (2018) BIO in cifre - Anticipazioni 2018 1-94 Available online at http://www.openfields.it/sito/wp-content/uploads/2018/09/Bio-in-cifre-2018-_-Anticipazioni.pdf (In Italian) pp 28

Tabella 9

Aziende di acquacoltura biologica, anni 2016 e 2017

	2016	2017
TOTALE NAZIONALE	40	40
VENETO	15	15
EMILIA ROMAGNA	15	11
PUGLIA	3	2
FRIULI VENEZIA GIULIA	1	2
LOMBARDIA	1	2
SARDEGNA	1	1
CALABRIA	1	1
TRENTINO ALTO ADIGE	1	1
UMBRIA	1	1
CAMPANIA	0	1
LAZIO	0	1
MARCHE	0	1
PIEMONTE	1	0

(Fonte SIB)

I question some of the assertions in the paper, not least that the UK was the first organic fish producer in 2009 (l. 68). Aarset, Tveteras and Norwegian and UK colleagues had been researching and producing papers for a decade on the subject - see Aarset, B. et al. (2004).

I corrected the paragraph and I introduced following sentence in the manuscript:

First European organic farms of salmon were accredited according to an IFOAM standard in 1999 (Aarset *et al.* 2004). In the following period, the United Kingdom was one of the leading country and in 2009

The European consumers' understanding and perceptions of the 'organic' food regime. The case of aquaculture. British Food Journal, 106, 93-105. It is also inconsistent with the statement you make in l. 263, where you state that 'Italian organic aquaculture is more than 20 years old ..'; this surely then predates 2009 by a decade

I don't understand completely the meaning of this comment, however, considering that we are in 2019 and fish organic production started in 2000 (see line 191 ... "Organic aquaculture production in Italy started in 2000 – 2001, with a few trout farms that were certified by independent certification bodies (AAVV, 2001) ..." it is about 20 years ago, so I cannot find anything wrong in that sentence.

English and grammar still require an overhaul e.g.

l. 50. ‘.. it is useful to consider Italy in an ..’.

l. 78. ‘.. in Europe is Ireland, which is ..’.

I sent again the manuscript for a second English revision, to the lecturer that I cited in the acknowledgment. I re-introduced all the English corrections she suggested me

Also, I dispute the fact that 100% of Irish farmed salmon and trout is organically produced, despite the BIM report.

I have just reported in the manuscript what is indicated in that report (BIM report), I did not find different information about organic aquaculture in Ireland.

Best regards,

Benedetto Sicuro

An overview of organic aquaculture in Italy

Benedetto Sicuro^{1*}

Highlights of the manuscript

Organic aquaculture in Italy is considered a promising sector however it never reaches expected previsions and shows a stationary low level of production (1.1% of total aquaculture production in 2015).

Blue mussel, gilthead sea bream and rainbow trout are the most important organically farmed species in Italy, and most of the organic fish farms are located along the Adriatic coast and in North East Italy.

The high costs of certification and fish feeds, the bureaucracy, the higher prices and the lack of appropriate marketing strategies are the main practical obstacles for Italian organic aquaculture.

An overview of organic aquaculture in Italy

Abstract

The total organic aquaculture production in Italy in 2015 was of 2347 t, and it accounted for almost 1.1% of the total aquaculture production. This situation is comparable with that of other western countries, where organic production accounts for about 1.5 – 2% of the total aquaculture production. Between 2013 and 2018, the number of organic fish farms in Italy has more than doubled, that is, from 17 to 41 farms. Most of these organic fish farms are located along the Adriatic coast and in North East Italy (Veneto region), and the main farmed species in that period was blue mussel, followed by gilthead sea bream and rainbow trout. Organic aquaculture is generally considered a promising and growing sub-sector of aquaculture in Italy and in other European countries, and a number of research initiatives have recently been implemented by the Italian Ministry of Agriculture and Forestry. However, despite these efforts, a clear fact has emerged: only a small percentage of Italian fish farmers demonstrated any interest in producing organically until 2017. The demand for organic aquaculture products in Italy is increasing, particularly among those people who regularly consume organic food. However, there are a number of critical aspects that still need to be addressed: the difficulty of introducing organic aquaculture products into large-scale retail operations, the high prices of the key fish feed ingredients, the difficulties in adapting Directive (EC) 710/2009 to aquaculture and the application of long-term marketing strategies. This paper tries to provide a realistic perspective of organic aquaculture, and thus includes not only the proximate causes (*i.e.* technical and regulatory aspects) of the current production, but also the remote historical, geographical, political and arithmetical reasons.

Key words: certified productions, European aquaculture, Italian aquaculture, organic
 25 aquaculture, quality of products, rainbow trout,

26

27 **Introduction**

28 Organic aquaculture answers an urgent and common demand of consumers for better
 29 quality seafood and a sustainable use of marine resources (Subasinghe *et al.* 2009;
 30 Turchini *et al.* 2009; Tusche *et al.* 2011). For this reason, in these last 20 years, in Italy
 31 and in Europe, consumer awareness about organic foods and organic fish production has
 32 promoted the diffusion of various types of seafood eco-endorsements, such as eco-
 33 labeling and certification (EU, 2014; Mente *et al.* 2011; Mente *et al.* 2012). The main
 34 aspect that makes organic aquaculture different from conventional aquaculture is the fish
 35 nutrition, which directly addresses consumer needs, food safety and environmental
 36 concerns (Ballester-Moltó *et al.* 2017; Komas *et al.* 2014; Mente *et al.* 2011; Mente *et al.*
 37 2012). A crucial issue is the reduction of fishmeal and fish oils in fish feeds with two
 38 main objectives: the use of: (a) sustainable sources of fish meal and (b) alternative
 39 vegetal feedstuffs (Menghe *et al.* 2006; Lund *et al.* 2011). In some cases, the limitations
 40 imposed in the use of fish feed ingredients can cause an even higher environmental
 41 impact than conventional aquaculture (Ballester-Moltó *et al.* 2017).

42 From its beginning, organic aquaculture (like almost any other organic production sector)
 43 has often been depicted as having positive possibilities and expected growth, that is, of up
 44 to 40 % (AA. VV. 2001; Mansfield, 2007; Prein *et al.* 2012; Nizza 2012; Di Marco *et al.*
 45 2017), but it has rarely passed 1 or 2 % of the total aquaculture production.

But is organic aquaculture in Italy really so promising and increasing, as has repeatedly been stated ? What is the realistic perspective of organic aquaculture in Italy and in other developed countries? Are the difficulties in the application of national rules the only reasons that can explain this low production ?

In order to try to answer to these questions, it is useful to include Italy in an international and European context, and to briefly consider the historical, geographical, political and social reasons that can explain this situation. In other words, to understand the real perspectives of organic aquaculture in Italy, or elsewhere, it is important to include the proximate and remote causes of the current status of organic aquaculture in the discussion. The analysis of the Italian status of organic aquaculture may serve as a comprehension and prevision model for other developed countries that, taken together, represent the area that could undergo the greatest increase in organic aquaculture in the future.

In light of the general upward trend of organic aquaculture products on the European market, the aim of this paper has been to review the organic aquaculture situation in Italy, and to consider the main driving forces that regulate this sector.

The role of European aquaculture

Blue mussel was the main organic production species in Europe in 2015 (Fig.1), followed by Atlantic salmon, carp, sea bass and sea bream. In 2010 and 2011, salmon and trout were the principal species organically farmed in Europe, while in Norway, organic salmon was 1.3% of the total production in 2012 (Zubiaurre, 2013).

68 First European organic farms of salmon were accredited according to an IFOAM standard
 69 in 1999 (Aarset *et al.* 2004). In the following period, the United Kingdom was one of the
 70 leading country and in 2009 the production of organic salmon was 4% of the total salmon
 71 farmed in the country. Ireland was the largest European producing country of organic
 72 salmon in 2012, with 9.600 t of production (Zubiaurre, 2013), and reached 22000 t in
 73 2015, thus representing almost 50% of the total European production. Organic
 74 aquaculture products are increasingly important on the Swiss market; a growth of 35% of
 75 market volume was observed from 2008 to 2009. A total of 7 organic trout farms produce
 76 about 300 t of organic trout in Switzerland (Kilcher *et al.* 2011). Organic aquaculture
 77 production has recently started in Greece (Perdikaris and Paschos 2010; Polymeros *et al.*
 78 2014), and it is also beginning in Turkey (Kayhan & Olmez 2014) and in Scandinavian
 79 countries (Paisley *et al.* 2010). The only abnormal case in Europe is Ireland, which is the
 80 leading country for organic salmon production in Europe, where the production of
 81 organic salmon was 69% of the total salmon production and organic trout was 30% of the
 82 total trout production in 2012 (Zubiaurre, 2013) and successively reached 100% of
 83 production. This extraordinary progress is exclusively due to a change in legislation. In
 84 fact, the entire Irish farmed salmon production (13.000 t in 2015) is obtained according to
 85 an organic standard, that is the Annual Aquaculture Survey 2016 issued by the Irish Sea
 86 Fisheries Board (BIM).
 87 (http://www.eumofa.eu/documents/20178/84590/Study+report_organic+aquaculture.pdf).
 88 The Irish case indicates that the harmonization of rules at a European level is a crucial
 89 issue for the future of organic aquaculture. For this reason, it is important to point out the
 90 efforts of the European Commission, which amended the previous regulation on organic

production (EC 88/2008) and produced a new regulation in April 2016 (EU 2016/673). This regulation contains more restrictive rules on the introduction of non-organic juveniles into organic farms, both for fish and bivalves, as well as an updated list of feed additives. These rules make the separation between conventional and organic farming clearer in all the productive phases and could improve fish feed quality, considering that it is a central issue for modern organic aquaculture (Ballester-Moltò *et al.* 2017).

Low numbers mean instability and turbulence: an unexpected mathematical side of the question

As the total number of organic farms can be considered as a physical system, it could be useful to consider whether this system is stable or not. In terms of system dynamics, it is easy to consider this system as a pendulum that oscillates about the equilibrium position. This equilibrium position is the current number of organic fish farms in Italy (or in Europe or elsewhere). Being composed of a low number of elements (*i.e.* Italian organic farms), this system is inherently unstable, as a small increase or decrease in the number of farms could result in a great oscillation (Tab. 1), which can easily cause either the end of the system or its transition to a new equilibrium position. This analogy helps to clarify why it is difficult to estimate organic aquaculture productions.

In Europe, the number of organic farms was about 75 in 2011 (EU, 2014). Therefore, only a few new farms per year influence the estimated growth to a great extent (Tab. 1). The growth of organic aquaculture has been relevant in relative terms, but not in absolute terms, and this fact has probably created excessive expectations. Even though there are no official statistics on organic aquaculture production at present, if the production

volumes are considered, it is likely that very few new farms have been founded or converted from conventional to organic throughout Europe in the last few years (Fig. 3). For example, in Greece there were 3 organic fish farms until 2013, and in Switzerland there are currently only 7 organic trout farms.

A snapshot of the Italian aquaculture situation: the effect of intra-sectorial forces on organic aquaculture

Organic aquaculture, by definition, is a modern extension of aquaculture, and it is based on an upgrade of the existing conventional aquaculture productive processes. For this reason, a brief description of the current situation of Italian aquaculture is useful to fully understand the status and potentialities of organic aquaculture.

Italian aquaculture is structured in the same ways as in other European countries, that is, it is largely based on a few species: namely, three finfish, rainbow trout (*Oncorhynchus mykiss* Walbaum 1792), European sea bass (*Dicentrarchus labrax* L.), gilthead sea bream (*Sparus aurata* L.), and two bivalve species, Mediterranean mussels (*Mytilus galloprovincialis* L.) and Manila clams (*Venerupis philippinarum* Adams & Reeve, 1850) (Bronzi *et al.* 2012). The production of rainbow trout reached 36000 tons in 2013, while the sea bass and gilthead sea bream volumes were 6300 and 6100 tons, respectively, and bivalve marine farming production reached 88000 tons. The overall value was € 393 million in 2013 (MiPAAF 2014). Italy is the main European producer of Manila clams (24600 tons in 2013), while other fish species with promising perspectives are sturgeons for caviar production, grey mullets (*Mugil sp.*), which are extensively farmed for the production of salted roe, also known as “bottarga”, and meagre (*Argyrosomus regius*

Asso, 1801). Bivalve farming is deeply rooted in Italy, and it is particularly developed along the Adriatic coast, with the Manila clam farms mainly being located in North East Italy. The annual fish consumption in Italy is currently less than 20 kg per person, and it is the first time in this century that the annual fish consumption has reached such a low value, with a negative trend of -4% from 2002 (ISMEA, 2013). Moreover, fish consumption is much lower in Italy than in other European countries, such as Portugal (60 kg), Spain (49 kg) and France (33 kg).

The regulatory aspects of organic aquaculture in Italy: the role of politics

One of the most important aspects that has influenced the diffusion of organic aquaculture in Italy and throughout the world is the adoption of shared and standardized procedures (Bronzi *et al.* 2011; Szeremeta *et al.* 2010). The introduction of standardized procedures has been perceived as crucial from the very beginning of modern Italian aquaculture (Roncarati *et al.* 2008), and several farmers voluntarily decided to apply internal rules in order to standardize quality, but these practices were only spontaneously adopted by farmers until 1999. Since 2001, an Italian consortium that represents the main stakeholders in the Italian fishery sector for the promotion of fish and seafood consumption (UNIPROM), has organized and promoted research initiatives on organic aquaculture and formulated a preliminary production protocol for organic aquaculture (AAVV 2001). This protocol was based on the FAO Code of Conduct of Responsible Fisheries (FAO 1995) and on Directive (EC) 1804/1999. Later, Directive (EC) 710/2009, which is the regulatory document for organic aquaculture in Europe, was adopted in Italy in July 2010. The Italian Ministry of Agriculture and Forestry supported the adoption of

Directive (EC) 710/2009 and constituted a permanent committee on organic aquaculture (AAVV, 2012). Directive EC 710/2009 introduced fundamental new indications, such as an organic logo and a clear list of ingredients for fish feeds. The principal institution involved in organic aquaculture certification in Italy is ICEA (Ethical and Environmental Certification Institute). Currently, the main food chain that diffuses organic fish is “ALMA VERDE BIO” (www.almaverdebio.it). Clear labeling is a crucial point for the future of organic aquaculture. Since the introduction of organic products onto the market, European consumers have appeared confused about the meaning of the term “organic” and are largely unaware of the certification processes (Aarset *et al.* 2004). Feucht and Zander (2014) showed that, even in Germany, where there is a deeply-rooted tradition of organic food consumption, there was still a necessity to improve organic fish labeling and communication with consumers.

Organic aquaculture productions in Italy

The total production of Italian organic aquaculture was of 2347 t in 2015, which represents 1.1% of the total Italian aquaculture production. In the past, organic aquaculture in Italy was at a constant level, that is at 1.5 – 2% of the total aquaculture production. Blue mussel was the main species organically farmed in 2015, with 2000 tons of production, while gilthead sea bream was the first fish farmed species, with a production of 153 t; rainbow trout is the second organically farmed species, with a production of 90 t (http://www.eumofa.eu/documents/20178/84590/Study+report_organic+aquaculture.pdf). The internal Italian demand for organic aquaculture products was already noticeable

183 when organic fish production began in Italy (Defrancesco, 2003), and in the last few
184 years, a willingness to pay a premium price for organically farmed fish has been noticed
185 (Maurarcher *et al.* 2013). Organic productions are well known by Italian consumers, and
186 Italy is in fact ranked 3rd in the world, after Australia and Argentina, for the use of
187 certified soil in organic agriculture production (AA VV 2012). Overall, the number of
188 agriculture organic certified farms in Italy increased from 48,269 in 2011 to 49,709 in
189 2012 (Ribeiro *et al.* 2010), and now represents 25% of the total European organic
190 production. Italian organic agricultural and livestock products are mainly exported to
191 Northern Europe. Organic aquaculture production in Italy started in 2000 – 2001, with a
192 few trout farms that were certified by independent certification bodies (AAVV, 2001). In
193 the subsequent years, some organic gilthead sea bream and European sea bass farms were
194 founded, following the application of a specific regulation for organic fish farming, that
195 is, Directive (EC) 710/2009 (Defrancesco 2003). Italian organic aquaculture production
196 was originally based on just a few aquaculture farms, but the number increased to 17
197 farms in 2013, thus showing a comparable situation with most other European countries.
198 Recent data on organic fish farms (SINAB, 2014; SINAB 2015) indicated an unexpected
199 increase to 41 farms in 2014 with a successive stationary phase until 2017 (SINAB,
200 2018), thus showing an increase of more than 140%. The small number of farms and this
201 sudden increase in 2014 make it difficult to clearly interpret this trend. However, this
202 number represents 5.1 % of the total number of Italian aquaculture farms, and it is
203 noticeably higher than the European percentage of 1.3% (with the exception of Ireland).
204 Should this trend be confirmed, it could indicate a quite positive change in perspective
205 that is in contrast with the rest of Europe (EU, 2014). Italian organic farms are mainly

located along the Adriatic coast (Fig. 2); the Veneto region (NE Italy) has the greatest number of organic aquaculture farms and is also the leading conventional aquaculture region. The most common organically farmed fish species is gilthead sea bream (Castellini *et al.* 2014).

These data show that Italian organic aquaculture has an inner relationship with conventional aquaculture. In fact, the most popular organic species are the most frequently farmed conventional species, with the only difference concerning the produced amount, in that organic gilthead sea bream production is higher than rainbow trout production, while rainbow trout production is higher than gilthead sea bream in conventional aquaculture. This fact can be explained considering that Italian rainbow trout farming is currently managed with traditional techniques and with traditional infrastructures, while marine aquaculture is a more recent activity and is consequently more open to technological improvements.

It seems that the positive growth perspectives expected at the international level, pertaining to organic aquaculture productions, such as that indicated by FAO, which estimated a growth of 40 – 60% until 2012 (Prein *et al.* 2012) and an expected growth of 20% per year between 2010 and 2020 (Nizza, 2012), do not show similar trends for Italy. Moreover, Italy is one of the countries with the highest numbers of processing plants for organic fish (http://epp.eurostat.ec.europa.eu/portal/page/portal/organic_farming/data/database), thus indicating a good internal demand for organic aquaculture products and a strong modern aquaculture specialization process (Guillotreau 2004).

Until 2013, organic aquaculture in Italy remained stationary at a low level, but this situation was comparable with the situations of other western countries (IFOAM 2010b), with the exception of Ireland (Fig. 3) (Budak *et al.* 2006; Defrancesco, 2003; Mente *et al.* 2011). Subsequently, from 2014 to 2017, the number of organic fish farms had unexpectedly more than doubled, thus representing a radically different situation from other European countries. The main explanation for this difference may be geographic (the local conditions positively affected the transformation of conventional farms into organic ones). In fact, if the distribution of organic farms in 2013 is compared with that of 2014-2018 (SINAB 2014; SINAB 2015; SINAB 2018), it is clear that the increase in the number of organic farms is principally due to the two regions, Veneto and Emilia Romagna, in which the number of organic farms doubled in 2014. It is clear that there are more opportunities for conversion from conventional to organic productions in areas in which aquaculture has traditionally developed.

Although some recent studies in Greece and in Italy have shown that organic feeds sustain a good performance of sea bass and sea bream (Di Marco *et al.* 2017; Mente *et al.* 2012), the diffusion of organic farming practices in small-size fish farms in Italy is principally hampered by the high costs of certification and fish feeds (IFOAM, 2010b) and by the excessive bureaucracy (SINAB, 2015). For instance, a cost-benefit assessment in a European sea bass farm has recently shown that the costs of certification and fish feeds are the main obstacles to the conversion from conventional to organic production (Zacchino *et al.* 2014). The adoption of Directive EC 710/2009 has been a fundamental achievement for Italian organic aquaculture and has promoted its diffusion, but there are still some problematic aspects for the farmers: the sanitary treatments based on natural or

vegetal compounds and probiotics, the mandatory utilization of only local fish strains; the mandatory spatial separation between conventional and organic cultures during all the productive phases and the restricted use of water oxygenation (Trocino *et al.* 2012; Tulli *et al.* 2012).

From the commercial point of view, there are also some critical aspects that should be addressed: the difficulty of introducing organic aquaculture products into the large-scale retail trade, the higher prices, compared to conventional food products, and the application of appropriate marketing strategies, following the example of Denmark (see the ORAQUA project (2007-2010): <http://www.icrofs.org/pdf/darcofIII/oraqua.pdf>).

A positive aspect recently emerged by the project BIOBREED (<http://www.biobreed.it/BioBreed/HOME.html>) is the positive consumer's perception of organic aquaculture products as reaction to a general negative sentiment of conventional aquaculture products. Italian consumers believe that pharmaceutical treatments are strongly reduced in organic aquaculture (Pulcini & Capoccioni 2018). Italian consumers will need to be informed and a clear labeling, (according the EU and international standards) is imperative in order to control the abuse of such terms as “organic” and “biological” in aquaculture products.

Conclusions

Italian organic aquaculture is 20 years old, but it is often considered to still be in its infancy, and this review indicates that it will probably remain in this situation in the future. It can be stated that this is a physiological state, thus Italian organic aquaculture can be considered a “proportioned dwarf” in the aquaculture sector.

274 Blue mussel, gilthead sea bream and rainbow trout are the most important organically
275 farmed species in Italy, and most of the organic fish farms are located along the Adriatic
276 coast and in North East Italy.

277 The high costs of certification and fish feeds, the bureaucracy, the higher prices and the
278 lack of appropriate marketing strategies are the main practical obstacles to Italian organic
279 aquaculture.

280 It appears that the Italian rules for organic aquaculture production are probably too
281 restrictive to promote organic farming, and this is just a part of the problem that affects
282 aquaculture production in general. For this reason, the main policy implication is that a
283 simplification should be introduced in order to sustain the internal production of organic
284 aquaculture and the entire sector.

285 The show of optimism repeatedly reported in the previsions about organic aquaculture in
286 Italy and in other developed countries should be tempered. The data of the last 20 years
287 on organic aquaculture clearly show that its production is just a small percentage of the
288 total aquaculture production.

289 In general terms, it is clear that the relationship between conventional and organic
290 aquaculture can easily be explained in a context of evolutionary relationships. In fact, the
291 emergence and diffusion of organic aquaculture show powerful analogies with the
292 emergence of a new species, in a process of intra-specific separation, which is well
293 known in biology. A new species (in this case organic aquaculture) originates from the
294 former one (conventional aquaculture), in a gradual process that is driven by internal
295 (aquaculture productions) and external (geographical and legislative) forces.

The vision and the perspective of the future of organic aquaculture would be greatly improved if the scientific community were able to include the organic aquaculture evolution in a general theoretical context, beyond the traditional boundaries of technical considerations that dominate modern scientific literature.

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466

Fig. 1

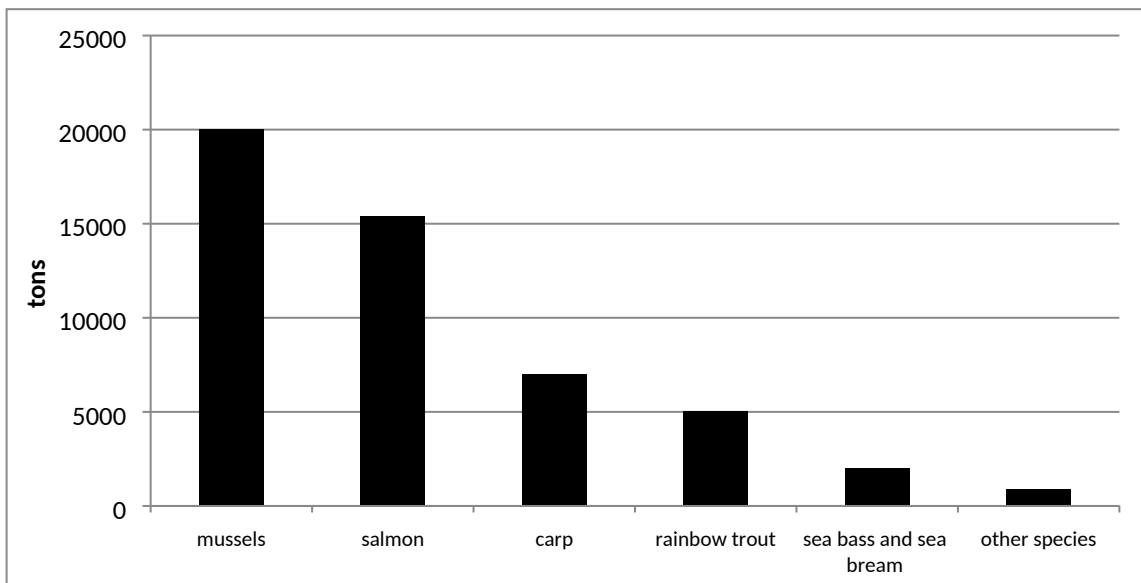


Fig 2.

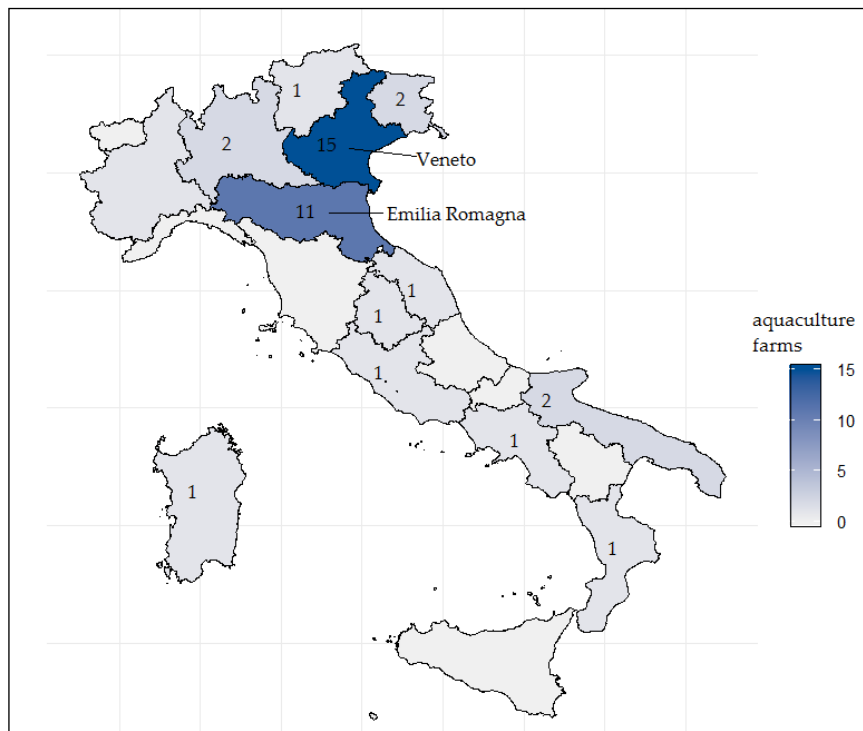
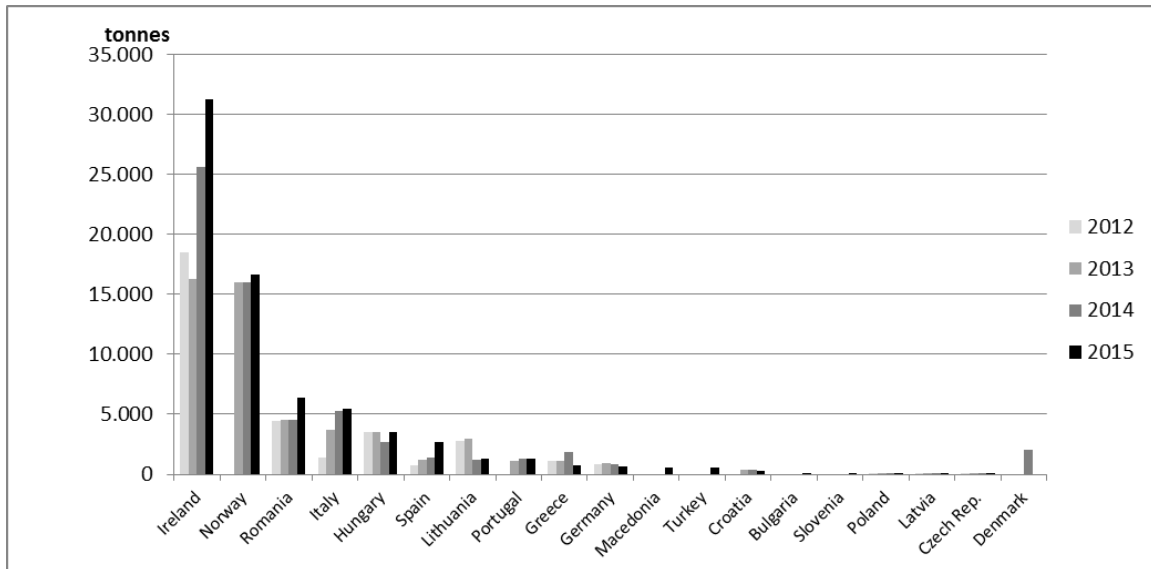


Fig. 3



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2 Tab. 1 Annual relative increment (%) of organic aquaculture production in main

3 European countries from 2012 to 2015

4

5

Country	2012 - 2013	2013 - 2014	2014 - 2015
Ireland	-12%	57%	22%
Norway		0%	4%
Romania	3%	-1%	41%
Italy	166%	44%	4%
Hungary	0%	-23%	31%
Spain	53%	15%	99%
Lithuania	10%	-61%	10%
Portugal		18%	0%
Greece	3%	66%	-61%
Germany	10%	-16%	-22%
Croatia		-16%	-12%

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2 Figure captions

3

4 Fig. 1 Number of organic aquaculture farms in Europe in 2009, divided by species
5 (IFOAM, 2010)

6

7 Fig 2. Number of organic aquaculture farms in Italy in 2017, divided by region (SINAB,
8 2018)

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10 Fig 3. Number of organic aquaculture farms in Europe from 2012 to 2015.

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1 **An overview of organic aquaculture in Italy**

2 Benedetto Sicuro

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5

6 **Running title:** An over. Organ. Aquac. Italy

7

Dear Editor,

I have tried to reply to the reviewer 2 requests at my best

I carefully searched for recent articles about Italian organic aquaculture. I included updated references in the manuscript.

.

I sent again the manuscript for a professional English revision to a lecturer, that I already acknowledged in the article, here her last email

“Dear Benedetto,

I am sending you the revised version. I have made a few suggestions that are perhaps not necessary, but might be useful to show the editor/referee you have paid attention to his/her comments. This person is probably not a mother-tongue (as deduced from his/her strange comments about grammar!). However, there were a few grammar mistakes in the version (e.g. where you forgot to remove a word). If you need a CV to send to him/her, I can send it to you. Let me know how this goes. “

I hope that you and the reviewer2 will consider my corrections as definitive, but I am still available to re-correct my manuscript, if necessary.

Best regards,

Benedetto Sicuro